DATA AND SUGGESTIONS FOR GRAPE SPRAYING MACHINES USING HYDRAULIC TYPES OF SPRAYS

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Insecticides and fungicides should be applied to a vineyard quantatively. That is, a precise amount of material is added to a known volume of water and applied to a definite acreage of grapes. When foliage is heavy, from 200 to 300 gallons of water will be necessary. Less gallonage may be used in the very early season sprays or in very young vineyards. The following information is presented to provide the grower with a basic understanding of grape spraying technology.

To do an effective job, the speed of the sprayer, the spraying pressure, and the gallonage of spray delivered per minute must all be coordinated to deliver a definite volume of spray material per acre. A spray pump capacity of 12 to 18 gallons per minute is needed if an entire row of grapes (or one side each of two rows) is going to be sprayed with one pass of the equipment. By spraying a single side of only one row and going through every row center twice, then a minimum pump capacity of 5 to 7 gallons would be needed.

A spraying pressure of from 300 to 450 pounds per square inch is required for hydraulic spraying.

The speed of travel through the grape rows should be about 2 miles per hour for very short rows and not over 3 miles per hour for long rows (Table 1). In short rows at 3 MPH the operation of the shut-off valves become more complicated with the frequent turns.

* Does not include air blast or concentrate sprays.

Table 1.

Miles per Hour (MPH)	Feet per Minute
2	176
2½	220
3	264

Power take-off sprayers should have a 'live' take-off if possible, to avoid losing pressure at the end turns as otherwise the end vines do not receive a sufficient volume of spray.

Wettable powder forms of spray materials are generally used and recommended as the insecticides and fungicides for grape spraying. These materials are not soluble in water and are difficult to keep in suspension in the spray tank. Positive, or propeller type agitation is necessary to keep the spray materials adequately distributed in the tank. Pump backflow or a nozzle directed into the spray tank to produce agitation usually is not adequate and would require a spray pump of much greater capacity and cost than would normally be used. The time required to spray one acre of grapes at various speeds and row widths is given in Table 2.

Table 2.

Row Width	MPH	Minutes per Acre
10 feet	2½	19.8
10 feet	3	16.5
9 feet	2½	22.0
9 feet	3	18.3

Assuming a row width of 10 feet, a speed of 2½ miles per hour and a rate of 200 gallons per acre (spraying entire row - both sides of a single row or insides of two rows), the total nozzle spray delivery should be 10.1 gallons per minute (200/19.8). The gallons per minute can be worked out for any speed, row width, or gallons per acre. In this case, spraying only one side of one row would require only 5.05 gallons per minute.

Once the gallonage per minute is determined, then the spraying pressure, number, and size of nozzles can be selected. For adequate spray coverage with heavy foliage, five or more nozzles should be used on each side of the row when using dilute sprays. Spraying machine companies and nozzle manufacturers usually have tables showing the gallonage delivered by their various nozzles at various spraying pressures. For example, Table 3 lists the Myers Jumbo Nozzle with the delivery per minute at three different spraying pressures.

Table 3.

Disc Aperature Number	Whirl Plate	GMP for pressures of: 350 #	375 #	400 #
# 2	Standard	.321	.331	.340
# 2	* 1/16 hole	.460	.473	.490
# 3	Standard	.443	.459	.476
# 3	* 1/16 hole	.796	.831	.852

* A 1/16 inch hole is drilled in the exact center of the standard whirl plate - This produces more gallons per minute, a narrower cone of spray and more "drive" to the spray stream - The whirl plates with the holes can be supplied by the manufacturer.

Referring to the requirement of 10.1 gallons per minute in the previous example, if 12 nozzles were used (six on each side of the sprayer) each nozzle should deliver 0.84 gallons per minute (10.1/12). Table 3 shows Disc #3, 1/16 hole whirl plate at 375 pounds pressure, delivers 0.83 gpm; in actual practice this nozzle at 350 psi would be adequate.

Grape leaves tend to hang over the grape clusters. This often prevents adequate spray coverage unless the spray streams are directed upward to lift the grape leaves and allow the spray to be deposited on the grape clusters and berries. Sufficient spray volume and pressure must be used to raise the grape leaves from beneath (note.....with air-blast sprayers, the leaves are lifted by the air).

It is important that the spray nozzles be directed at an upward angle, especially the upper nozzles that apply the spray to the heavier foliage areas. The entire spray pattern should apply spray from the base of the grape trunk to the top-most leaves.

Single Curtain Trellis

The single curtain trellis, where rows are 8 to 10 feet apart, may be sprayed with a fixed spar boom. Spars on which the nozzles are mounted should be 46 inches apart (Figure 1.). On a standard width sprayer the nozzles will be about in line with the outside of the sprayer wheels. This places the nozzles sufficiently close to the vines so that they can be tilted at an upward angle and still not have the spray directed over the top of the trellis. The nozzles are also a sufficient distance away from the vines to allow the spray stream from each nozzle to spread into a slightly wider pattern and still have enough drive force left to lift the foliage (Figure 2A). All nozzles should be mounted with pipe elbows so they can be tilted both vertically and horizontally.

Double Curtain Trellis

The double curtain trellis places the canes and vine areas to be sprayed about 2 feet closer to each side of the sprayer; this makes the spray rows 4 feet narrower (Figure 2B). The fixed spars for the single curtain trellis are too far apart (46 inches) to be used satisfactorily with the double curtain trellis consequently, the nozzles and spars must be moved toward the center line of the sprayer. Since side spars do not adequately cover the top and inner "shoulders" of the vines trained to the double curtain system, an additional overhead "T" shaped boom should be added (Figure 3).

More nozzles will usually be required with the double curtain system in order to cover the top portions of the trellis. The use of nozzles (1 to 5, Figure 3) on each side of the sprayer are recommended to apply spray to the canes hanging from the trellis wires. Two nozzles directed at a downward angle (6 and 7, Figure 3) on each side of a "T" extension are used to spray the inner "shoulder" of the double trellis curtains (Figure 4).

The overhead "T" structure of the boom should be high enough to clear the tops of the trellis and trellis posts by 12 inches or more, or about 7 to 7½ feet above ground level. The horizontal arm of the "T" boom should extend over the first cordon trellis wire or about 4 feet from the row center. It is essential to brace the overhead "T" boom to the sprayer or tank body by cross-braces to prevent pipe vibration and breakage (Figure 5).

A typical nozzle arrangement for the "T" boom type of spar using 350 pounds spraying pressure is given below.

The three nozzles (3, 4 and 5, Figure 3) on each side of the center spar (total, 6 nozzles) are equipped with #3 discs and 1/16 hole whirl plates to deliver 0.796 gallons per minute each or a total of 4.78 gallons for the six nozzles.

The two nozzles (1 and 2, Figure 3) on each side of the center spar (total, 4 nozzles) are equipped with #3 discs and standard whirl plates to deliver 0.443 gallons per minute each, or a total of 1.77 gallons for the 4 nozzles.

The two nozzles on each end of the overhanging boom (6 and 7, Figure 3) (Total, 4 nozzles) are equipped with #3 discs and 1/16 hole whirl plates to deliver 0.796 gallons per minute each, or a total of 3.18 gallons for the 4 nozzles.

The 14 nozzles total 9.73 gallons per minute spray delivery, which is sufficiently close to the 10.1 gpm as calculated above.

The grape spray boom for the double curtain trellis system was developed in cooperation with USDA, ARS, Agricultural Engineering Service.

Figure 1. Fixed spar type grape spray boom for single curtain grape trellis. Six nozzles on each spar - double nozzles at lower position with one nozzle tilted upward and the other directed horizontally to spray the lower portion of the grape trunks and ground shoots.

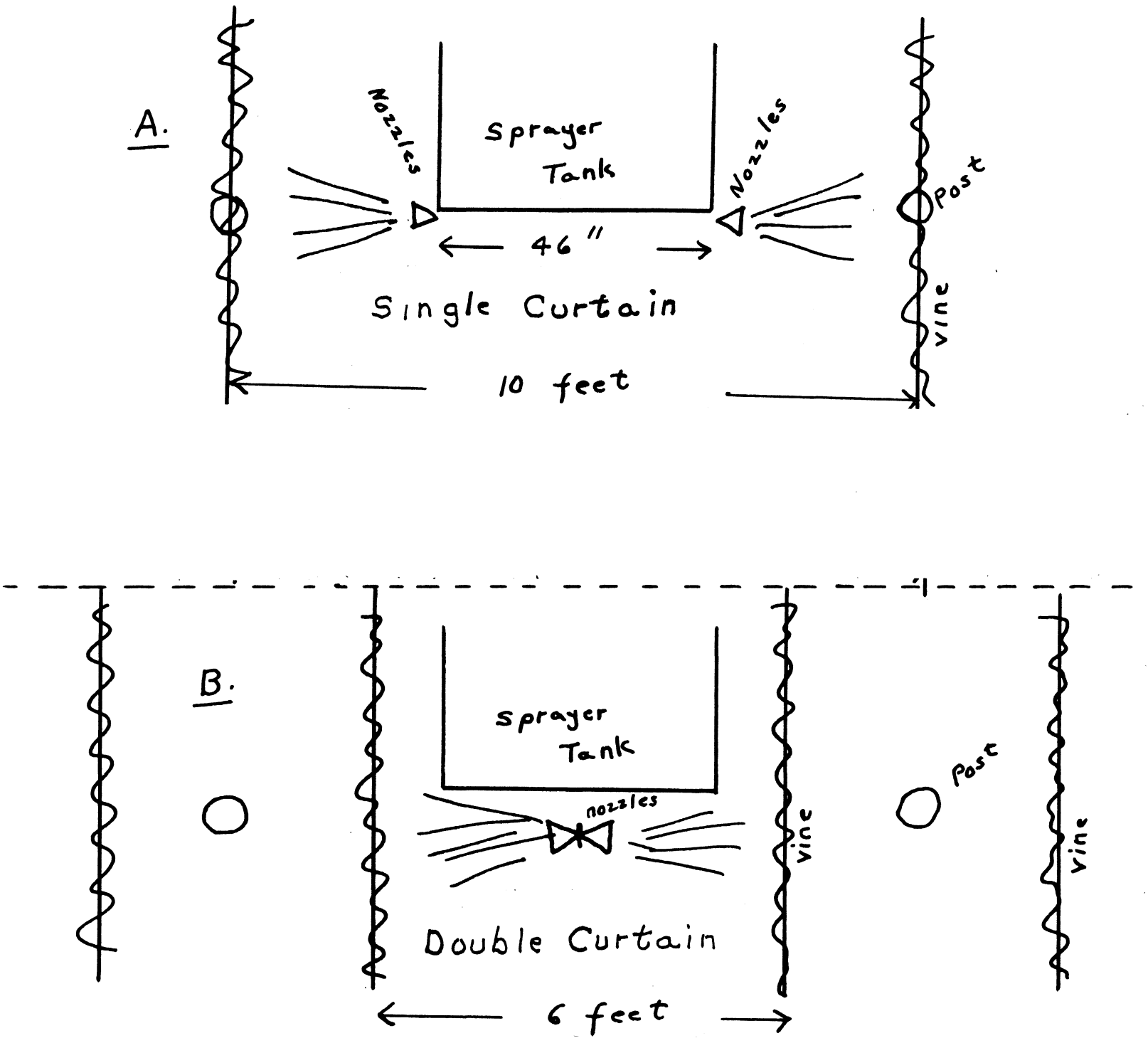

Figure 2. Comparison of vine row widths between single and double curtain grape trellises as viewed from above.

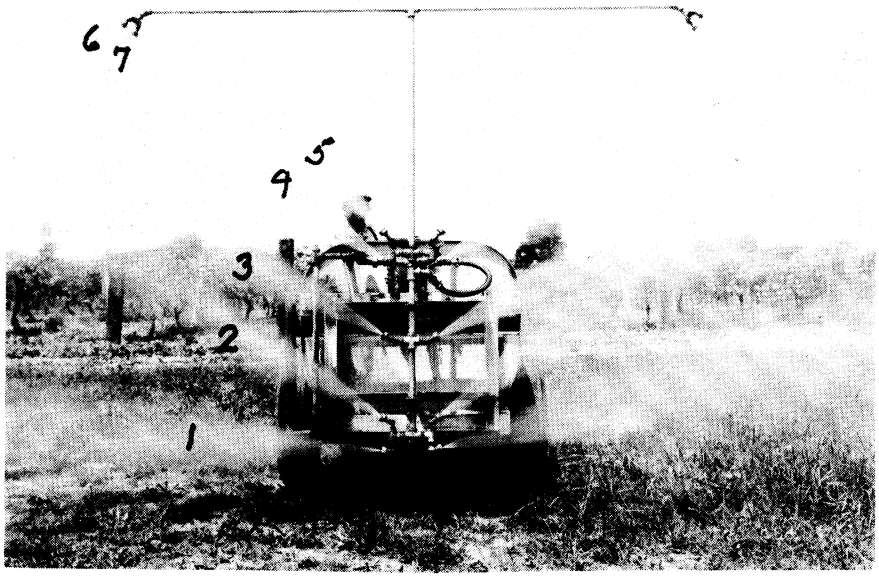

Figure 3. Fixed spar retracted and combined with overhang "T" boom for double curtain grape trellises. Total of 14 nozzles.

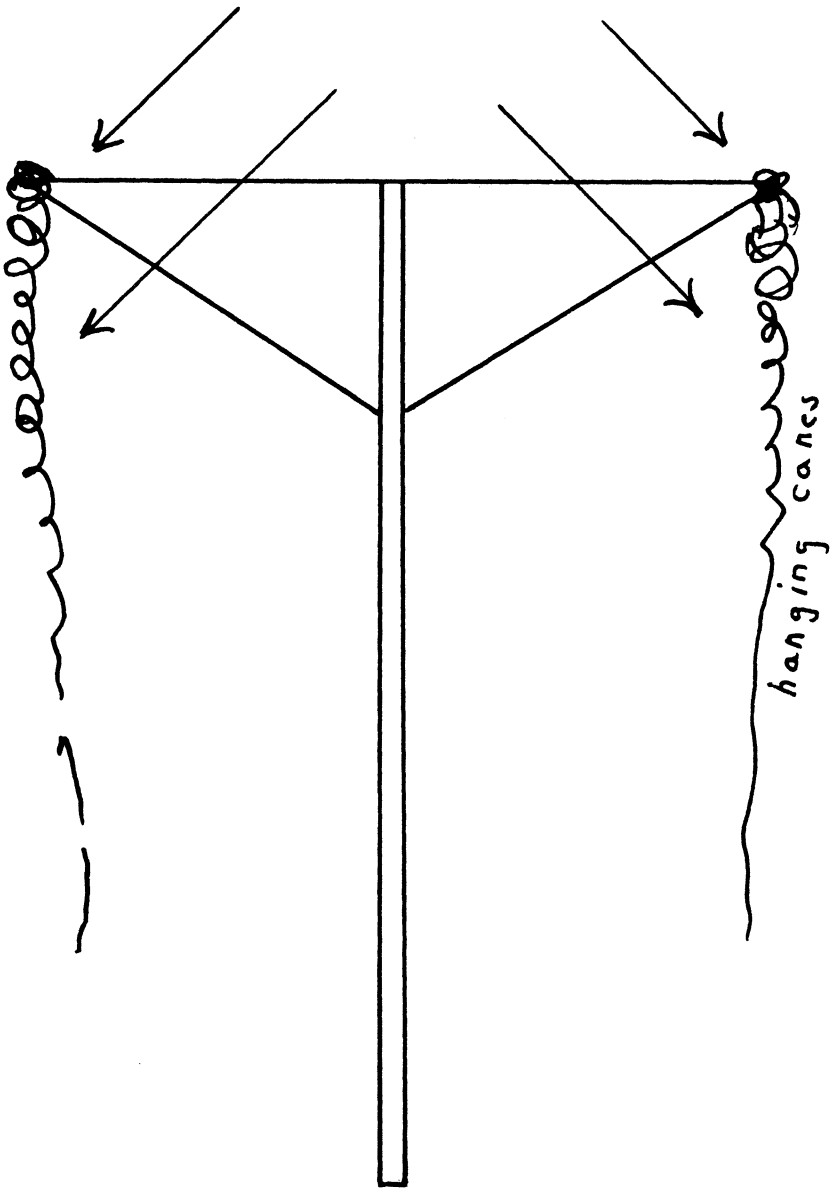

Figure 4. Cross section of double curtain grape trellis. Arrows indicate areas difficult to spray unless supplementary overhead nozzles are used.

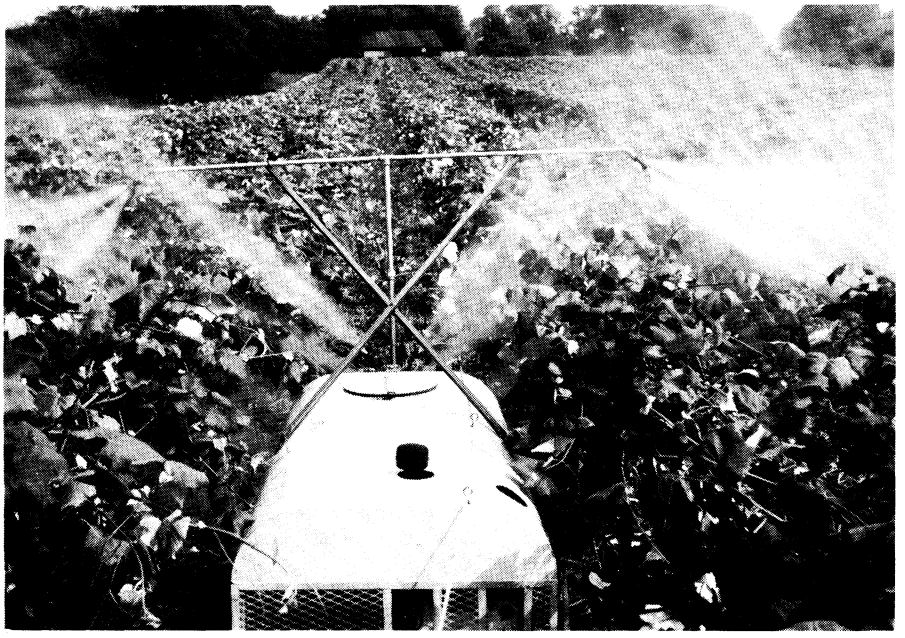

Figure 5. Cross-bracing to sprayer body for overhang "T" boom.

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Supplement to Mimeo Series 345 Horticulture

"Data and Suggestions for Grape Spraying Machines Using Hydraulic Types of Sprays". 2/13/68

Partial list of parts and materials needed for constructing "T" boom for grapes on double curtain trellis:

24	1/4 inch street ells
2	1/2 inch tee
4	1/2 to 1/4 inch bushings
14	1/4 inch close brass nipples
2	1/2 inch close nipples
2	1/2 inch 45° elbows
1	1/2-3/4-1/2 tee
2	3/4 inch pipe crosses
5	3/4 inch tees
10	3/4 to 1/4 bushings
1	3/4 union
1	shut-off valve operated from tractor
2	1/2 inch galv. pipe 44 inches (across top boom)
3	3/4 extra strength pipe lower at 15 inches middle at 11 inches top at 30 inches (3/4 inch union between top and middle section)

lower nozzles at 10 inches above ground

2	1" square tubing for cross braces - length depends upon sprayer used

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Nozzles (female threading) are attached to two 1/4 inch street ells, the last ell attached to the 1/4 to 3/4 inch bushing with 1/4 inch brass close nipple. The two street ells allow for both horizontal and vertical adjustment of the nozzles. In case a nozzle is hit it will usually break at the brass nipple and can be quickly replaced with a new bushing, street ell and nipple - this eliminates digging broken pipe thread out of the nozzle proper.

Materials for mounting-brackets will depend upon type of spray tank.

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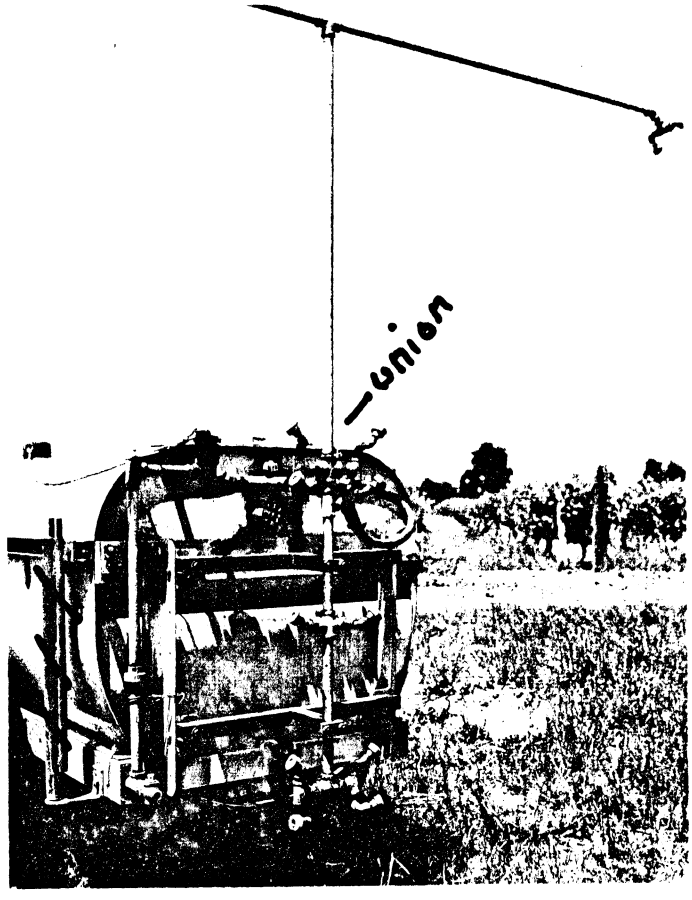

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